

# Commodity Flow Profile



## WEST VIRGINIA STATE FREIGHT PLAN



November 2023

*Tech Memo*

# West Virginia State Freight Plan

## *Commodity Flow Profile*

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*date*

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## 1.0 INTRODUCTION

### 1.1 Data and Methodology

This Commodity Flow Profile uses the Freight Analysis Framework (FAF)<sup>1</sup> database to complete an analysis of freight commodity flows in the state of West Virginia. Produced through a partnership between Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA), FAF integrates data from a variety of sources to create a comprehensive picture of freight movement across states and major metropolitan areas by all modes of transportation. Sources used by FAF include data from the 2017 Commodity Flow Survey (CFS); international trade data from the Census Bureau; and data from agriculture, extraction, utility, construction, service, and other sectors.

This analysis employs FAF version 5.4.1 (hereafter, “FAF5”), which provides forecasts on tonnage and values by origins and destinations, commodity type, and mode. This analysis used 2019 as the base year and 2050 as the future year. Since the entire state of West Virginia is just one FAF region, the data was disaggregated to estimate commodity flows by county within the state.<sup>2</sup> Commodity activity in a county could be more or less than the average inferred from the economic equations, as that activity could be because of activity which are not related to employment; but using information available for all counties consistently handles all commodities and does not require further expansion (which is preferable over other methods).

The full data set is accessible through the *West Virginia Freight Analysis System Tool*. The tool also provides statistics on the intermediate forecast year 2035.

### 1.2 Report Organization

This Commodity Flow Profile examines West Virginia freight movements by mode, direction, commodity type, and trading partner for both tonnage and value using FAF5 data. This analysis evaluates both domestic and international flows of goods by truck, rail, air, water, pipeline, multiple modes, and other modes in 2019 and 2050. The directional split includes inbound, outbound and internal flows.

### 1.3 Key Findings

The main takeaways from the analysis of West Virginia commodity flows are as follows:

- The rise in higher per-unit-price commodities such as pharmaceuticals, precision instruments, and electronics is anticipated to drive the increase in overall freight value.
- From 2019 to 2050, the entire freight system is projected to carry less tonnage yet higher values. Tonnage is expected to decline by 42 million tons, but increase in value by \$97 billion.

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<sup>1</sup> [https://ops.fhwa.dot.gov/freight/freight\\_analysis/faf/](https://ops.fhwa.dot.gov/freight/freight_analysis/faf/)

<sup>2</sup> Disaggregation from FAF Region in West Virginia to counties in West Virginia was done using reported county-level employment by industry (classified according to the North American Industrial Classification System, NAICS), and commodity activity according to industry activity from the Bureau Of Economic Analysis Input-Output Model's Make and Use tables.

- The most common mode of transportation for coal, the rail network, is projected to be the mode most affected by the decline in coal.

## 2.0 COMMODITY FLOW PROFILE

Overall, in 2019, about 326 million tons of freight worth \$127 billion were transported to, from, and within West Virginia. In 2050, the total tonnage transported is projected to decrease slightly to 285 million (a 12.7 percent decrease), driven by an expected continued decline in the quantities of coal, discussed further in Section 2.3. The total value of goods moved, however, is projected to increase to \$224 billion (a 76.4 percent increase), as high-value products such as pharmaceuticals and machinery are expected to comprise larger shares of the volume of goods moved. Sections 2.1 through 2.5 detail the state-level commodity flow analysis. Sections 2.6 and 2.7 provide summaries of the county-level FAF5 disaggregation, and introduce the freight analysis system tool, respectively.

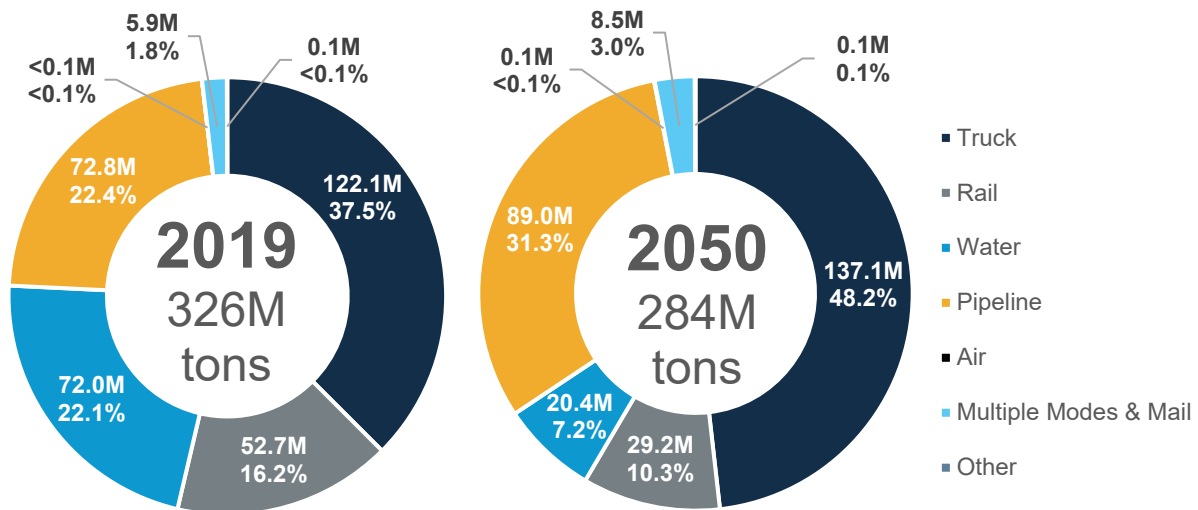
### 2.1 Modal Split

Figure 2-1 shows the total tonnage by mode for 2019 and 2050. Truck-based freight accounts for the largest modal share (nearly 38 percent in 2019). By 2050, trucks are projected to carry 137 million tons, accounting for 48 percent of 2050 total freight tonnage. Unlike most other states, in West Virginia, pipeline is the second-largest freight mode by tonnage with about 73 million tons in 2019, approximately 22 percent of total tonnage. In 2050, pipelines are estimated to carry 89 million tons of goods, representing 31 percent of total flows. West Virginia is the fourth largest energy-producing state in the United States.<sup>3</sup> Energy products, including coal, fuel oils, and gasoline, account for more than 99 percent of total pipeline commodity flow (basic chemicals account for less than 1 percent of total pipeline flow). As a major energy products producer, more than 77 percent of West Virginia's total pipeline tonnage in 2019 flowed outward, and more than 79 percent of total pipeline tonnage is estimated to travel outbound in 2050. After pipeline, the region's ports and waterways transported the third-largest share of total tons. In 2019, approximately 72 million tons, representing 22 percent of total tonnage, were transported by water. By 2050, waterways and ports are estimated to lose over 50 million tons (a loss of over 70 percent). Only 20 million tons (7 percent of total 2050 tonnage) are projected to be transported by water.

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<sup>3</sup> <https://www.eia.gov/state/?sid=WV>

Figure 2-1: WV Freight Tonnage by Mode, 2019 and 2050

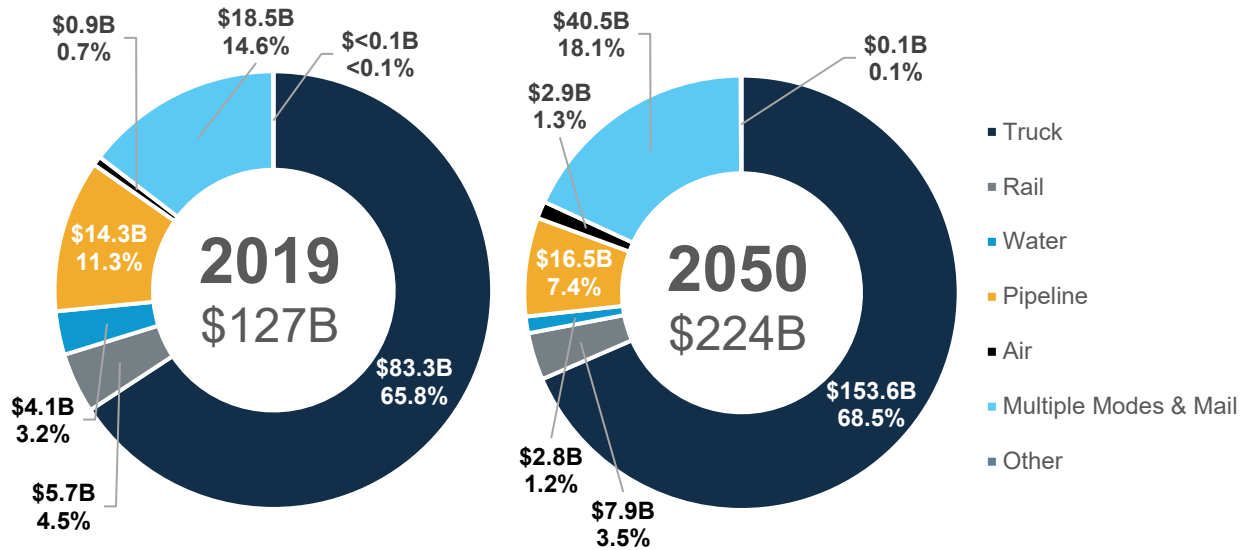


Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

In terms of value, the majority of West Virginia's goods are moved by truck. The total value by mode is summarized in Figure 2-2 for 2019 and 2050. As shown in the figure, trucking accounts for 66 percent of the total value in 2019 and is projected to account for 69 percent in 2050. Multiple modes & mail is the second-most valuable mode, accounting for 15 percent of total value in 2019. More than \$40 billion worth of commodities are expected to move via Multiple modes & mail by 2050, accounting for 18 percent of the total 2050 value of goods moved in the state. Pipeline is the third-leading mode by value. In 2019, pipeline carried 11 percent (\$14 billion) of the total value, and as of 2050, the proportion is projected to reduce to 7 percent (\$16 billion) of the total value. The absolute pipeline tonnage value is projected to increase by 22 percent between 2019 and 2050, however, due to the relatively low per-unit price of pipeline products (\$196 per ton in 2019 and \$185 per ton in 2050), the pipeline value increase is not as significant as tonnage. Meanwhile, in 2050, the total truck value and multiple modes & mail value are estimated to increase by 85 percent and 119 percent respectively, thus the relative pipeline value is expected to decrease proportionally.



Figure 2-2: WV Freight Value by Mode, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

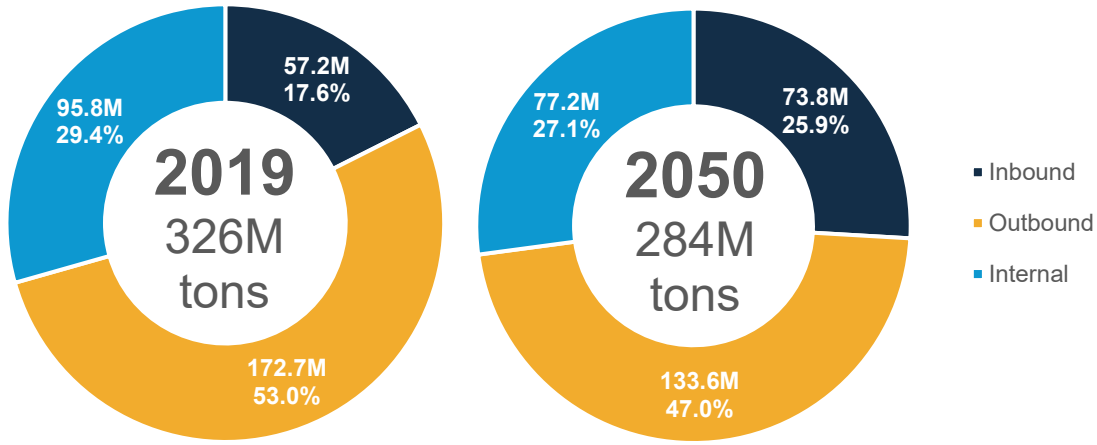
## 2.2 Directional Split

Figure 2-3 shows the flow of commodities by tonnage in West Virginia by direction in 2019 and 2050. Outbound traffic makes up the largest share of freight in West Virginia by tonnage. In 2019, nearly 173 million tons (53 percent of total tonnage) were transported out of West Virginia. By 2050, approximately 134 million tons, accounting for 47 percent of 2050 total tons, are expected to travel outbound. This decrease is likely due to the forecasted contraction of the coal industry within the state. Internal flows (origin and destination in West Virginia) account for the second-largest share of freight by tonnage. In 2019, 29 percent of total tons were transported internally in West Virginia. In 2050, the proportion of internal flow is projected to decrease slightly to 27 percent. Inbound traffic is the only directional split that is projected to have a tonnage increase from 2019 to 2050. In 2019, 57 million tons of commodities, accounting for 18 percent of total tons were transported to West Virginia. In 2050, 74 million tons, representing 26 percent of total tonnage, are estimated to travel inbound.

In summary, between 2019 and 2050:

- Outbound tonnage is expected to **decrease** by 23 percent, from 173 million tons in 2019 to 134 million tons in 2050;
- Internal tonnage is expected to **decrease** by 19 percent, from 96 million tons to 77 million tons; and
- Inbound tonnage is expected to **increase** by 29 percent, from 57 million tons to 74 million tons.

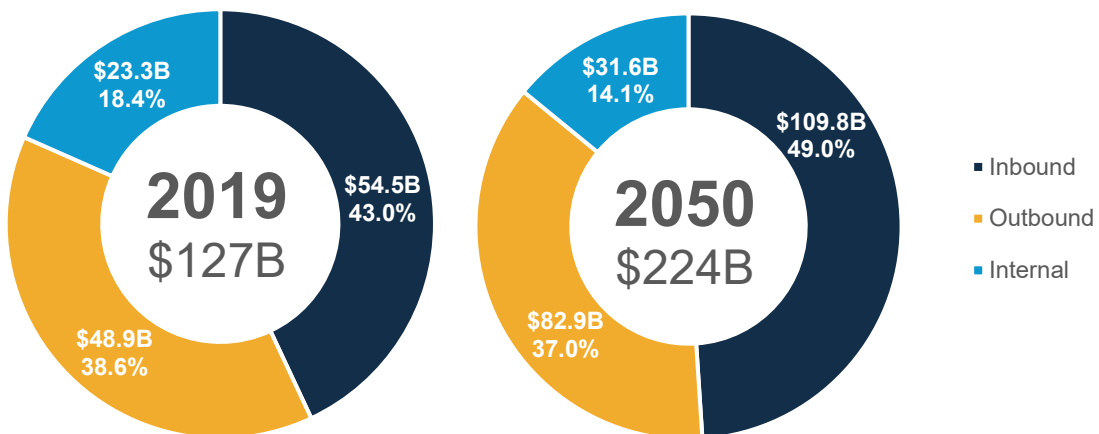
Figure 2-3: WV Freight Tonnage by Direction, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-4 shows the value of freight flows by direction in 2019 and 2050. Inbound traffic makes up the largest share of freight in West Virginia in terms of value. In 2019, 43 percent of the total value was transported inbound. By 2050, approximately 49 percent of the total value is estimated to travel inbound. Outbound flow accounts for the second-highest share of freight by value. In 2019, 39 percent of the total value was shipped out of West Virginia. In 2050, the share of outbound value is projected to decrease to 37 percent. In 2019, 18 percent of the total value was transported internally within West Virginia. As of 2050, the share of internal movement is estimated to decrease to 14 percent total value.

Figure 2-4: WV Freight Value by Direction, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

## 2.3 Top Commodities

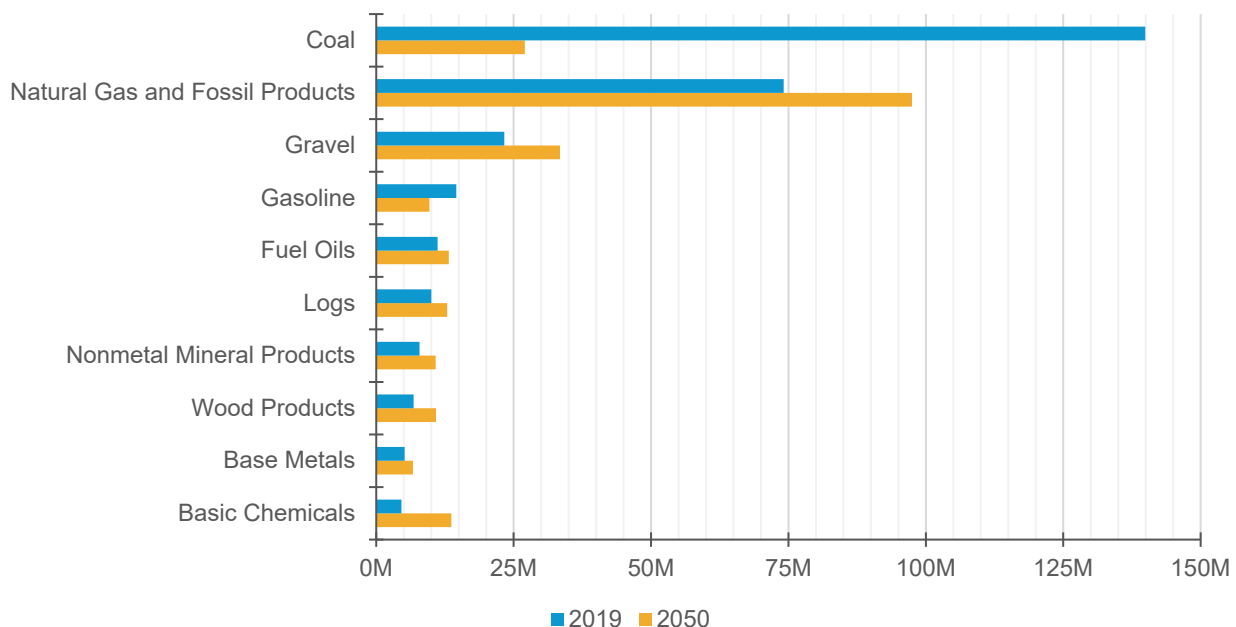
West Virginia is one of the nation's major coal and energy hot spots. In 2021, West Virginia was ranked as the second-largest coal producer in the U.S. and it produced 14 percent of the nation's total coal production.<sup>4</sup> The top commodities by tonnage and value in West Virginia are shown in Figure 2-5 and Figure 2-6. In 2019, coal was the largest commodity type transported to, from, and within West Virginia. Approximately 140 million tons of coal, valued at \$8 billion were transported in all directions. With the gradual decline of the coal industry, the tonnage and value of coal are projected to show a substantial decline through 2050. In 2050, 27 million tons of coal valued at \$3 billion are expected to be transported to, from, and within West Virginia.

Natural gas and fossil products were the second-largest commodity for West Virginia in terms of 2019 tonnage at 74 million tons valued at \$14 billion. In 2050, natural gas and fossil products is projected to become the largest commodity group in terms of tonnage (97 million tons), and the third-largest commodity in terms of value (\$19 billion).

Besides energy products, West Virginia's top freight commodities include bulk building products, such as gravel, logs, and other wood products. These primary resources are characterized by low unit prices.

Measured by value, natural gas and fossil products was the top commodity group moved in West Virginia in 2019. Pharmaceutical products and machinery were the second- and third-largest commodity groups by value moved in 2019. By 2050, pharmaceuticals and plastics/rubber are expected to overtake energy products and become the top two commodities by value.

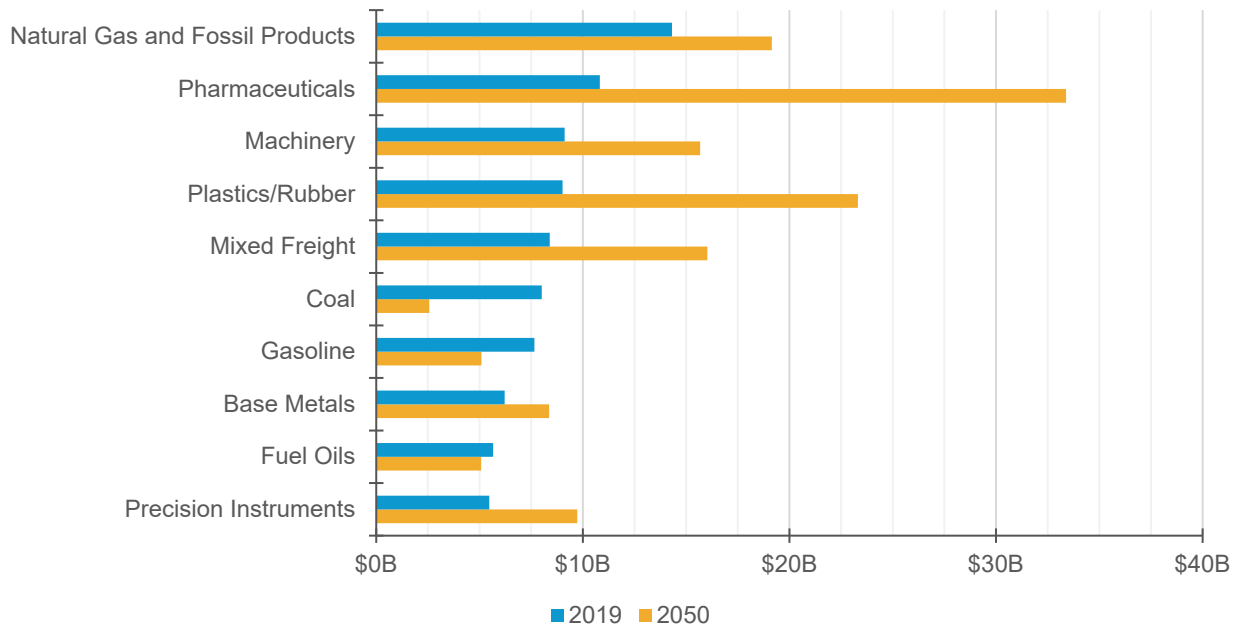
**Figure 2-5: WV Top 10 Commodities by Tonnage, 2019 and 2050**



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

<sup>4</sup> <https://www.eia.gov/state/print.php?sid=WV>

Figure 2-6: WV Top 10 Commodities by Value, 2019 and 2050



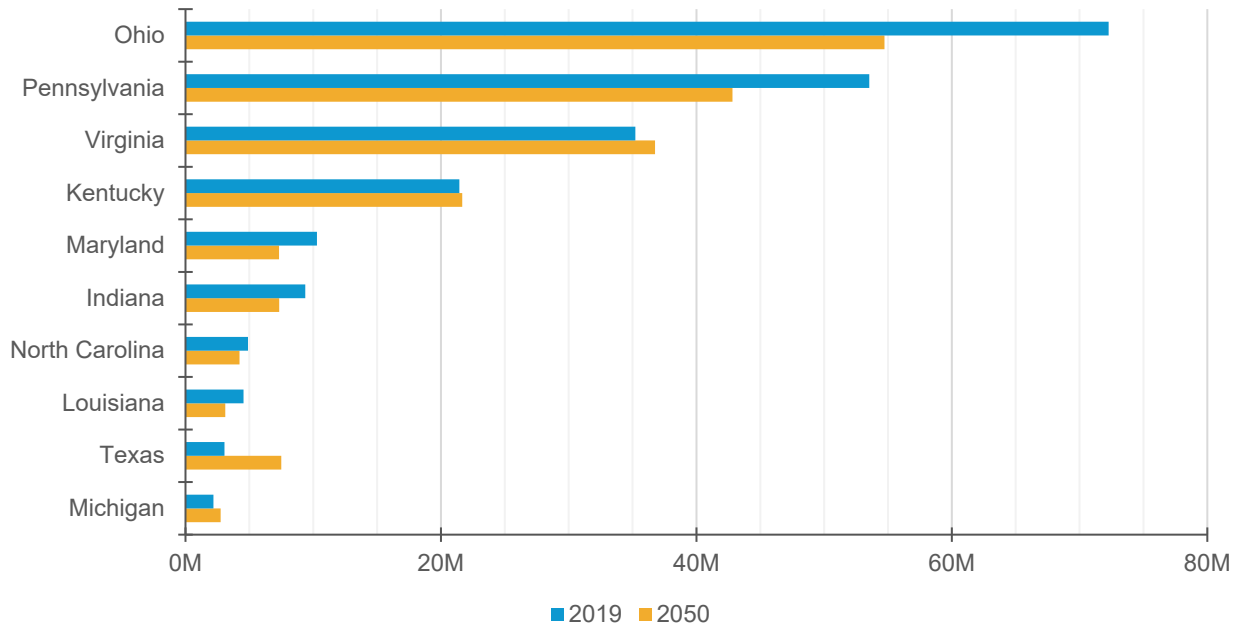
Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

## 2.4 Domestic Trading Partners

Figure 2-7 and Figure 2-8 show the top trading partner states by tonnage and value respectively. In terms of tonnage, Ohio, Pennsylvania, Virginia, Kentucky, and Maryland were the top five trading partner states in 2019, and will make up four of the top five trading partner states in 2050. In 2019, the top 10 states accounted for more than 94 percent of total tonnage. By 2050, the top 10 are projected to make up approximately 91 percent of total tonnage.

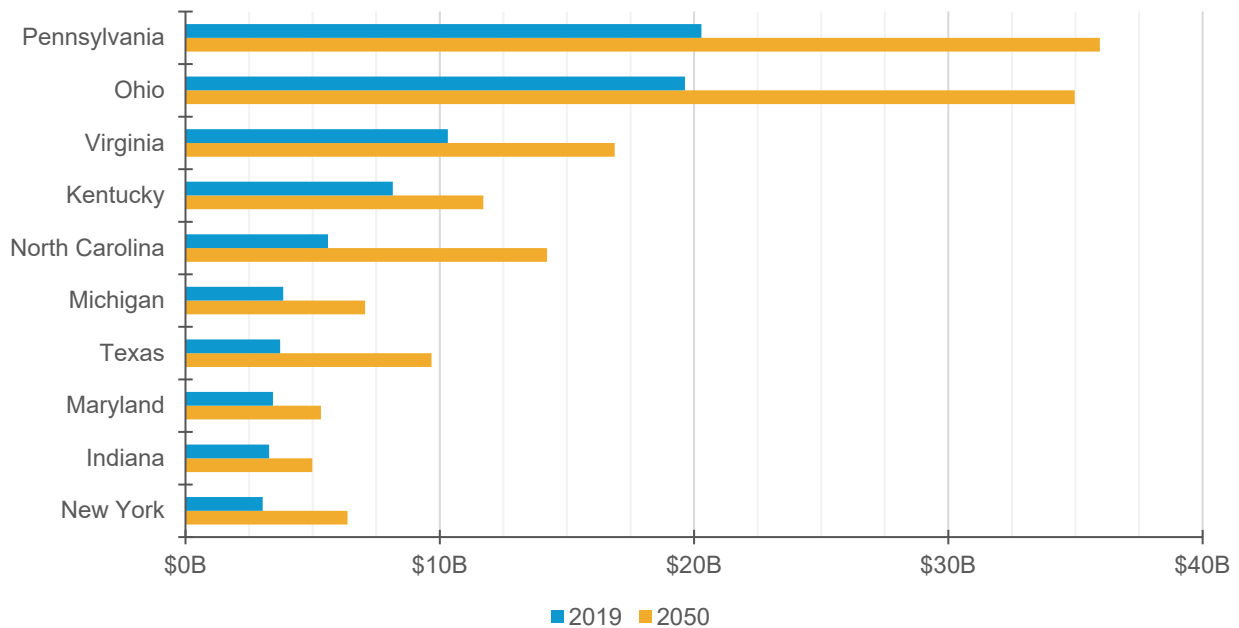
Measured by 2019 value, Pennsylvania, Ohio, Virginia, Kentucky, and North Carolina were the top five trading partner states and will make up the top five trading partner states in 2050. In 2019, the top 10 states accounted for nearly 79 percent of the total value. By 2050, the top 10 trading partners are projected to make up more than 76 percent of the total value.

Figure 2-7: WV Top 10 Interstate Trading Partners by Tonnage, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-8: WV Top 10 Interstate Trading Partners by Value, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

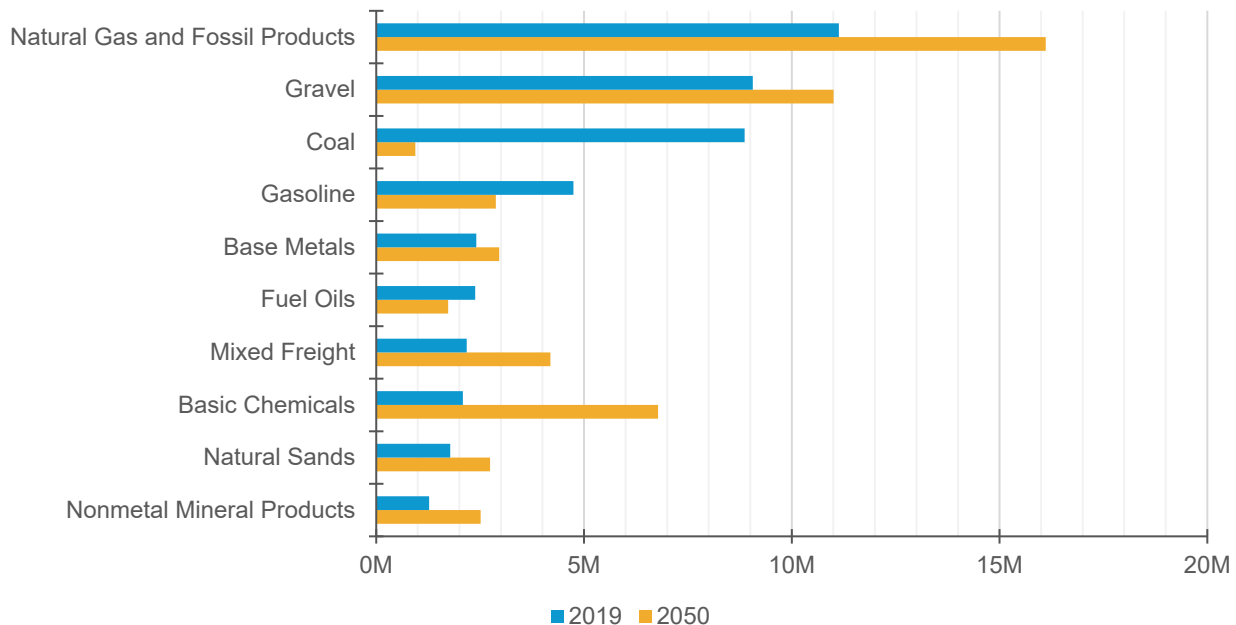
### 2.4.1 Inbound Goods

Figure 2-9 and Figure 2-10 summarize the top commodities transported into West Virginia in terms of tonnage and value in 2019 and their 2050 projections. Natural gas and fossil products (11 million tons), gravel (9 million tons), coal (9 million tons), gasoline (5 million tons), and base metals (2 million tons) were the leading commodities in 2019. The top 10 commodities together made up 80 percent of the total 2019 inbound tonnage.

In 2050, natural gas and fossil products (16 million tons), gravel (11 million tons), basic chemicals (7 million tons), mixed freight (4 million tons), and plastics/rubber (3 million tons) are projected to be the leading commodity types. The inbound tonnage of plastics/rubber is estimated to surge between 2019 and 2050. In 2019, plastics/rubber ranked 11<sup>th</sup> of the inbound commodities (1 million tons, not shown in Figure 2-9). In 2050, plastics/rubber is projected to become the fifth-largest inbound commodity. The top 10 commodities are projected to make up 74 percent of the total inbound tonnage in 2050.

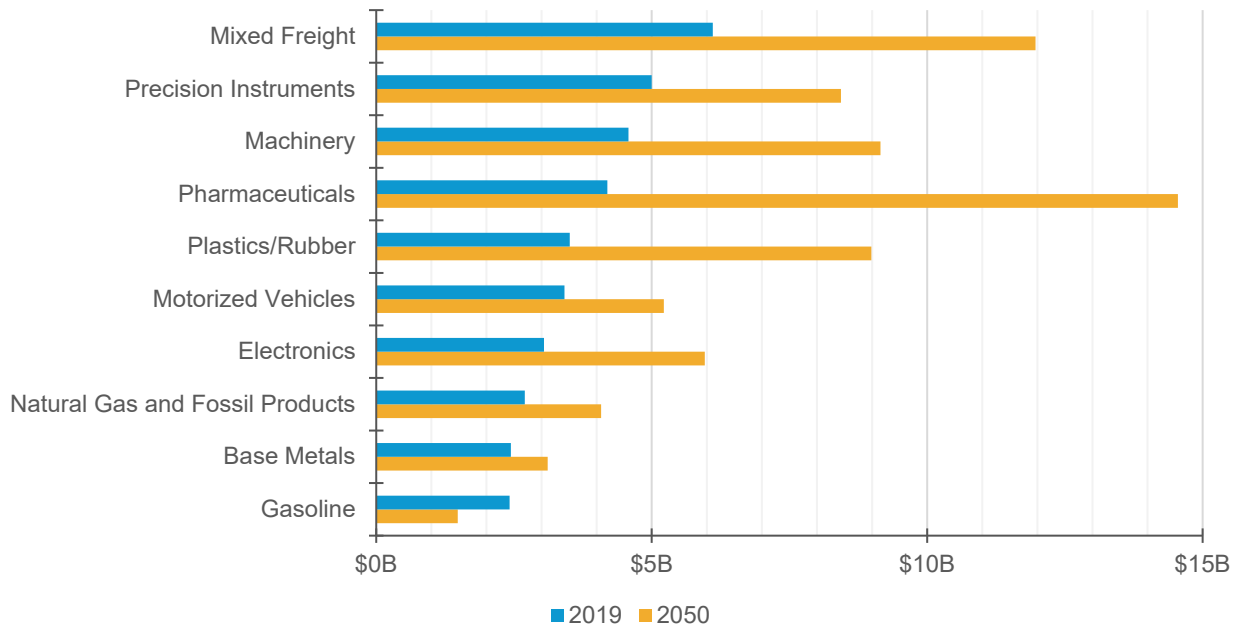
In terms of 2019 value, mixed freight (\$6 billion), precision instruments (\$5 billion), machinery (\$5 billion), pharmaceuticals (\$4 billion), and plastics/rubber (\$4 billion) were the leading commodity types. The top 10 commodities made up approximately 69 percent of the total value. In 2050, pharmaceuticals (\$15 billion), mixed freight (\$12 billion), machinery (\$9 billion), plastic/rubber (\$9 billion), and precision instruments (\$8 billion) are projected to be the leading commodity types in terms of value. The top 10 commodity types are projected to make up nearly 75 percent of the total 2050 value.

**Figure 2-9: WV Top 10 Inbound Commodities by Tonnage, 2019 and 2050**



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-10: WV Top 10 Inbound Commodities by Value, 2019 and 2050



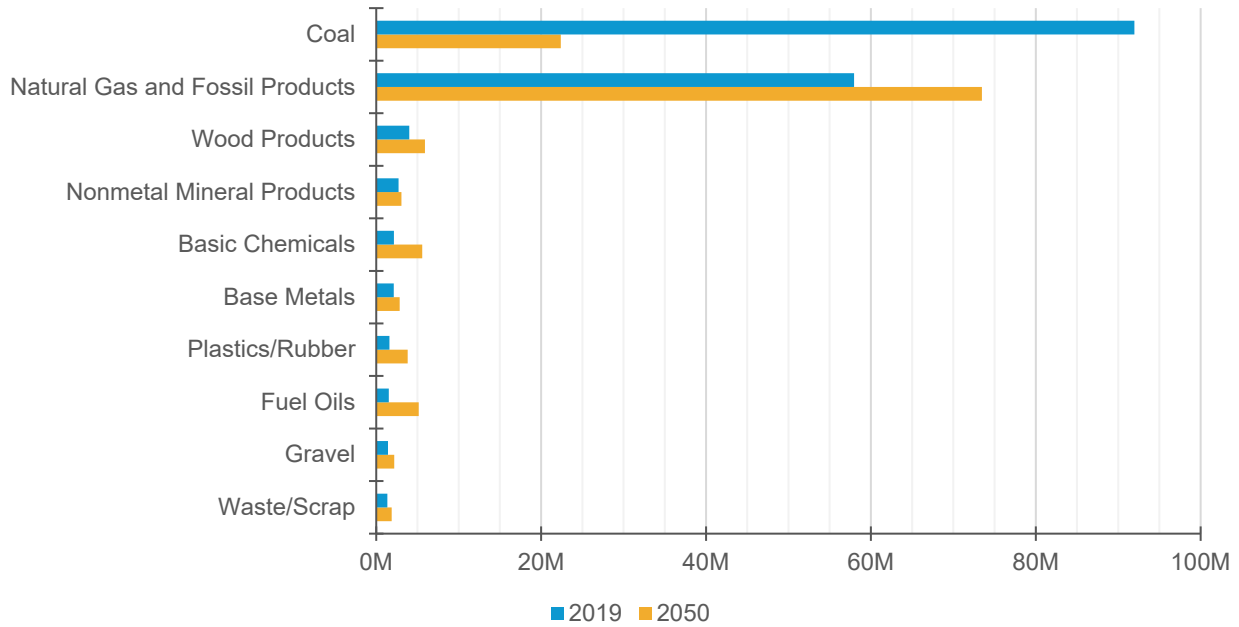
Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

## 2.4.2 Outbound Goods

Figure 2-11 and Figure 2-12 summarize the top commodities shipped from West Virginia in terms of tonnage and value in 2019 and the 2050 projections. Coal (92 million tons), natural gas and fossil products (58 million tons), wood products (4 million tons), nonmetal mineral products (3 million tons), and basic chemicals (2 million tons) were the leading outbound goods in 2019. The top 10 commodities together made up 97 percent of the total 2019 outbound tonnage. In 2050, natural gas and fossil products (73 million tons), coal (22 million tons), wood products (6 million tons), basic chemicals (6 million tons), and fuel oils (5 million tons) are projected to be the leading commodity types. The top 10 commodities are projected to make up 95 percent of the total outbound tonnage in 2050.

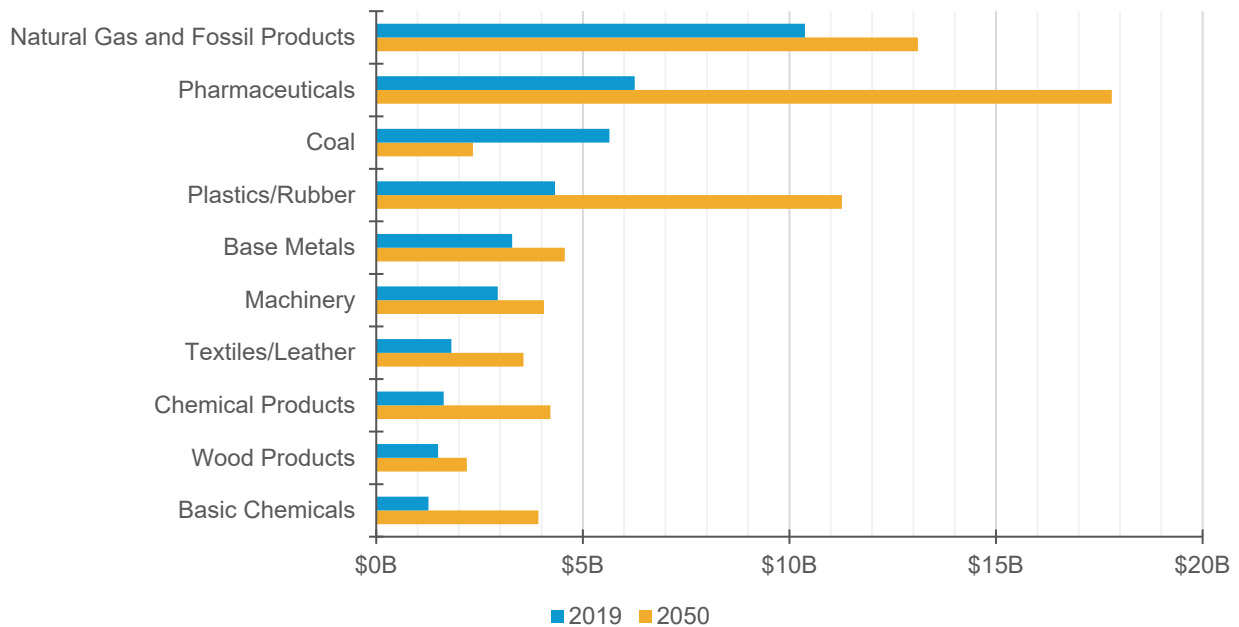
In 2019, natural gas and fossil products (\$10 billion), pharmaceuticals (\$6 billion), coal (\$6 billion), plastics/rubber (\$4 billion), and base metals (\$3 billion) were the leading commodity types. The top 10 commodities made up approximately 80 percent of the total outbound value. In 2050, pharmaceuticals (\$18 billion), natural gas and fossil products (\$13 billion), plastics/rubber (\$11 billion), base metals (\$5 billion) and chemical products (\$4 billion) are projected to be the leading commodity types in terms of value. The top 10 commodity types are projected to make up nearly 81 percent of the total 2050 outbound value.

Figure 2-11: WV Top 10 Outbound Commodities by Tonnage, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-12: WV Top 10 Outbound Commodities by Value, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.



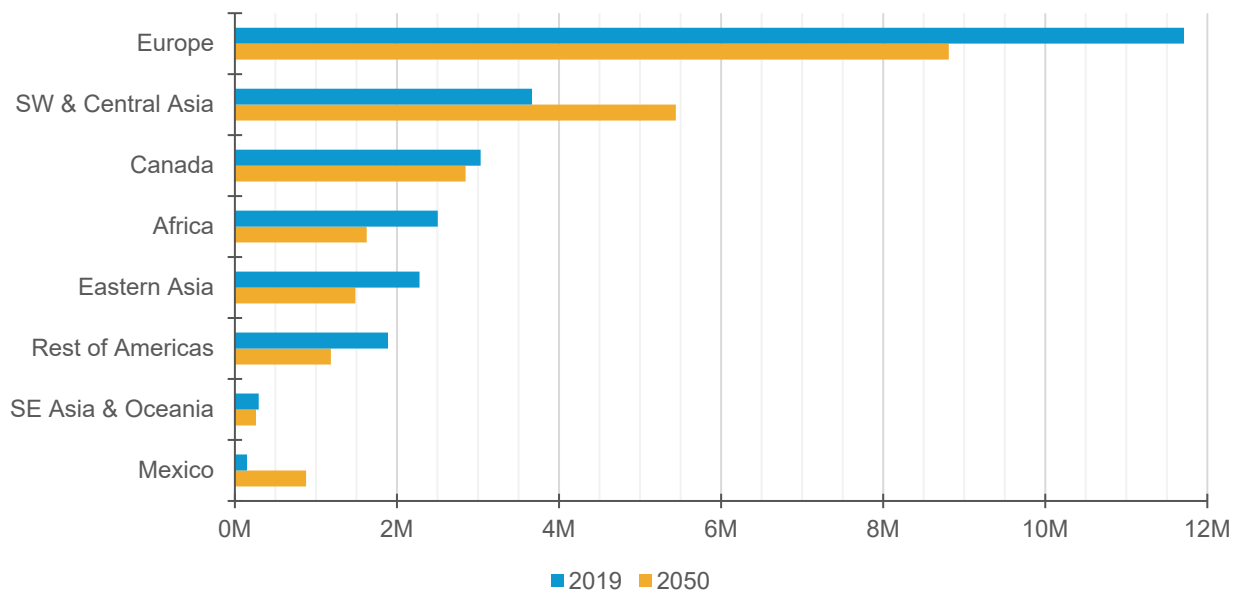
## 2.5 International Trading Partners

FAF5 aggregates the world's countries into eight international trading zones. In this analysis, international trade can enter or exit through any port in the United States as long as it originates, terminates, or connects through West Virginia. In 2019, 26 million tons of goods, valued at \$9 billion were imported to or exported from West Virginia. In 2050, 23 million tons, valued at \$16 billion are estimated to be imported to or exported from West Virginia. Figure 2-13 and Figure 2-14 summarize the total tons and value by international trading partner in 2019 and their 2050 projections.

In terms of tonnage, Europe was West Virginia's largest foreign market. Nearly 12 million tons of goods were transported to or from Europe, representing 46 percent of total international trade tonnage in 2019, and in 2050, 39 percent of international goods are projected to be shipped to Europe. Southwest & Central Asia was the second leading international trading market. In 2019, 14 percent of total international tonnage was transported to or from Southwest & Central Asia; the proportion is estimated to reach 24 percent in 2050. Canada is the third leading international trading partner for West Virginia. In 2019, 12 percent of total tonnage was transported to or from Canada, and in 2050, 13 percent of total international tonnage is estimated to ship to or from the region.

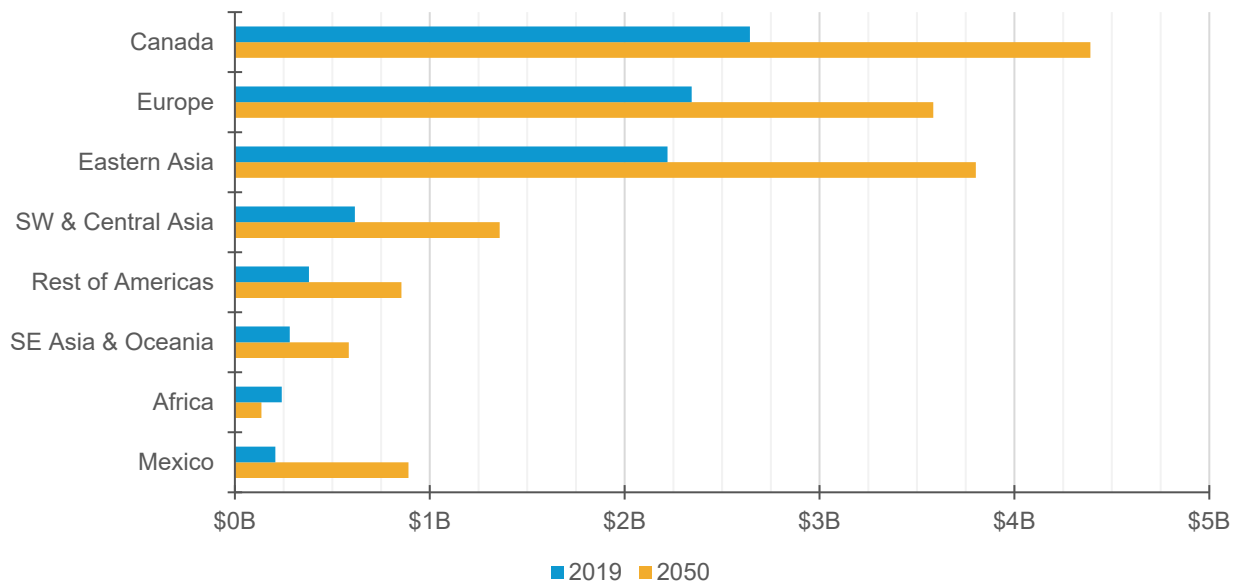
In terms of value, Canada is the state's largest trading partner. In 2019, the commodity flow between West Virginia and Canada made up 30 percent of the state's international trade value, and in 2050, the proportion is estimated to be 28 percent. Europe was the second-largest international trading partner zone in 2019. In 2019, the goods shipped between West Virginia and Europe represented 26 percent of the total international trade value and in 2050, the proportion is estimated to be 23 percent. Eastern Asia was the third major international trading partner zone in 2019. The commodity flow between the state and this region made up 25 percent of the total international commodity flow value, and the proportion is estimated to slightly decline to 24 percent in 2050.

**Figure 2-13: WV Top International Trading Partners by Import and Export Tonnage, 2019 and 2050**



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-14: WV Top International Trading Partners by Import and Export Value, 2019 and 2050



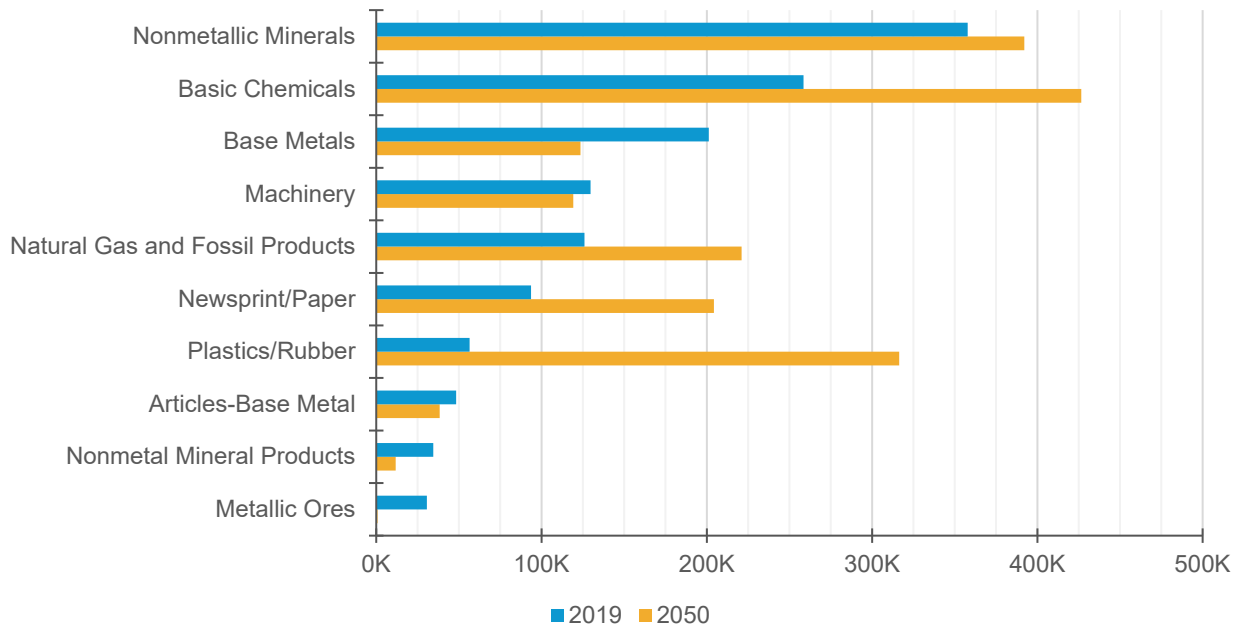
Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

### 2.5.1 Inbound Goods/Imports

In 2019, West Virginia had more than one million tons of goods imported from foreign regions, and in 2050, the value is estimated to double to two million. Figure 2-15 and Figure 2-16 summarize the top commodities transported to West Virginia from international trade zones in terms of tonnage and value in 2019 and their 2050 projections. Nonmetallic minerals (358 thousand tons), basic chemicals (259 thousand tons), base metals (201 thousand tons), machinery (130 thousand tons), natural gas and fossil products (126 thousand tons) were the leading commodities in 2019. The top 10 commodities together made up 90 percent of the total 2019 international inbound tonnage. In 2050, basic chemicals (427 thousand tons), nonmetallic minerals (392 thousand tons), plastics/rubber (316 thousand tons), natural gas and fossil products (221 thousand tons), and newsprint/paper (204 thousand tons) are estimated to be the leading commodity types. The top 10 commodities are projected to make up 93 percent of the total international inbound tonnage in 2050.

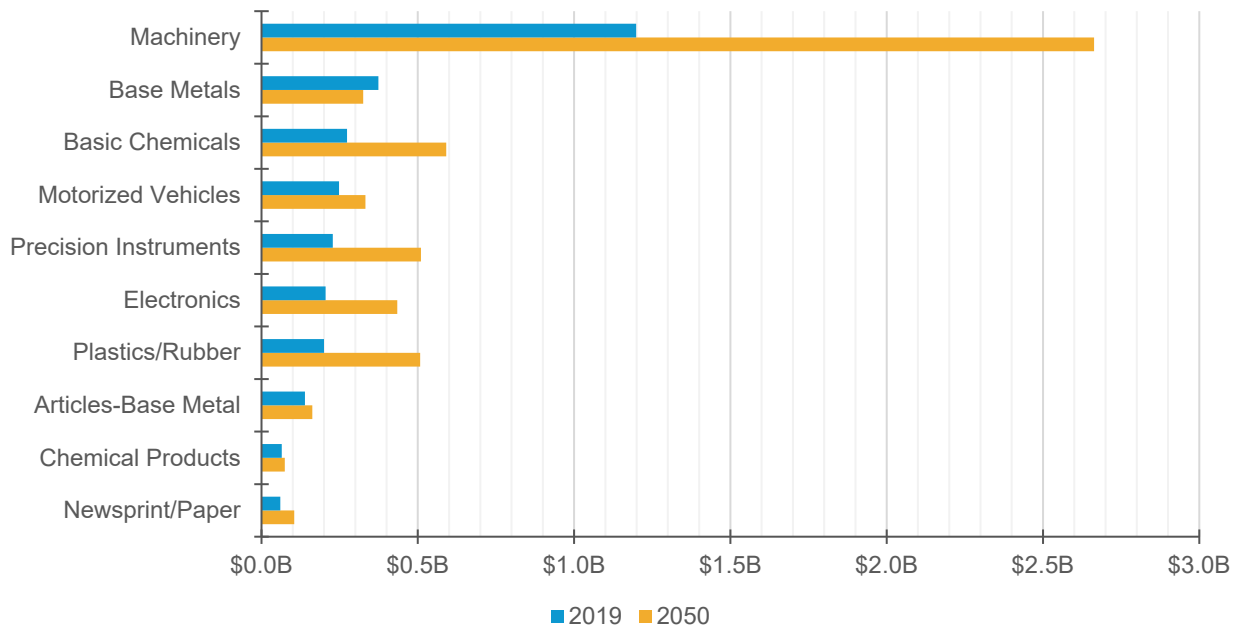
In 2019, machinery (\$1 billion), base metals (\$374 million), basic chemicals (\$274 million), motorized vehicles (\$248 million), and precision instruments (\$228 million) were the leading commodity types. The top 10 commodities made up approximately 92 percent of the total foreign inbound value. In 2050, machinery (\$3 billion), base metals (\$591 million), precision instruments (\$510 million), plastics/rubber (\$507 million), and electronics (\$434 million) are projected to be the leading commodity types in terms of foreign inbound value. The top 10 commodity types are projected to make up nearly 93 percent of the total 2050 international inbound value.

Figure 2-15: WV Top 10 International Import Commodities by Tonnage, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-16: WV Top 10 International Import Commodities by Value, 2019 and 2050



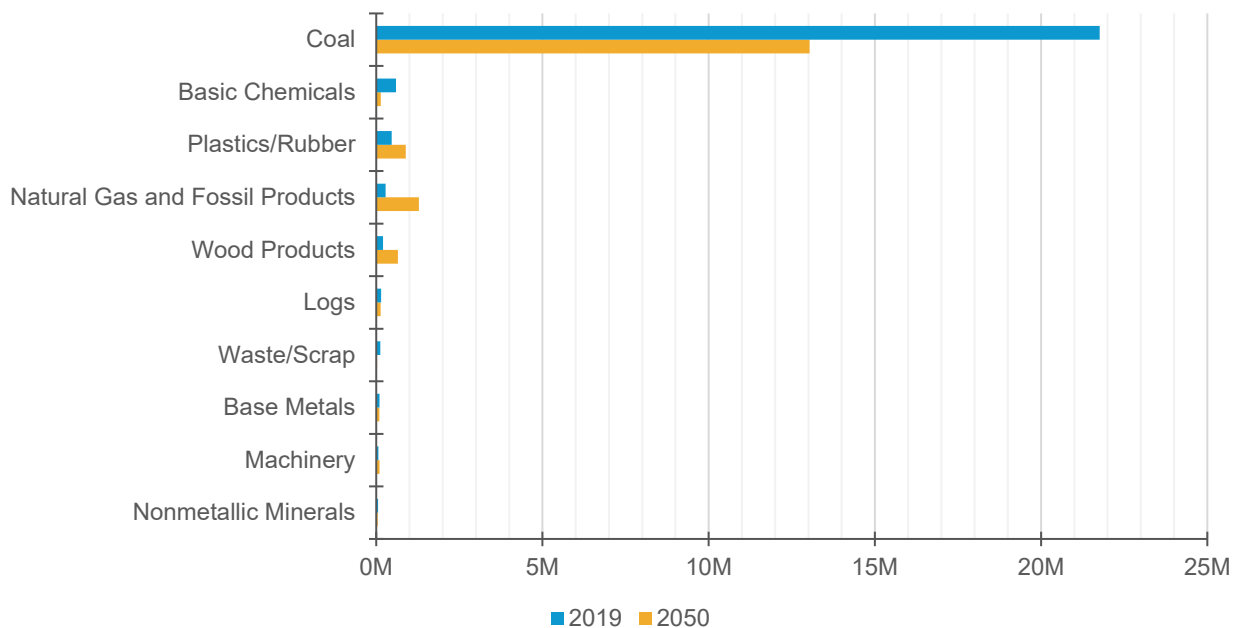
Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

## 2.5.2 Outbound Goods/Exports

In 2019, West Virginia had more than 24 million tons of goods, valued at \$6 billion exported to foreign regions, and in 2050, the tonnage is estimated to slightly decrease to 20 million with value increased to \$9 billion. Figure 2-17 and Figure 2-18 show the top commodity types exported from West Virginia to international trade zones in terms of tonnage and value in 2019 and their 2050 projections. Coal (22 million tons), basic chemicals (596 thousand tons), plastics/rubber (466 thousand tons), natural gas and fossil products (282 thousand tons), and wood products (207 thousand tons) were the leading commodities in 2019. The top 10 commodities together made up 97 percent of the total 2019 international outbound tonnage. In 2050, coal (13 million tons), fuel oils (3 million tons), natural gas and fossil products (1 million tons), plastics/rubber (890 thousand tons), and wood products (651 thousand tons) are estimated to be the leading commodity groups. Fuel oils is projected to increase significantly between 2019 and 2050. In 2019, fuel oils ranked 11th of the exported commodities (54 thousand tons, not shown in Figure 2-17). However, in 2050, it is projected to become the second-largest international export commodity in terms of tonnage. The top 10 commodities are projected to make up 95 percent of the total international outbound tonnage in 2050.

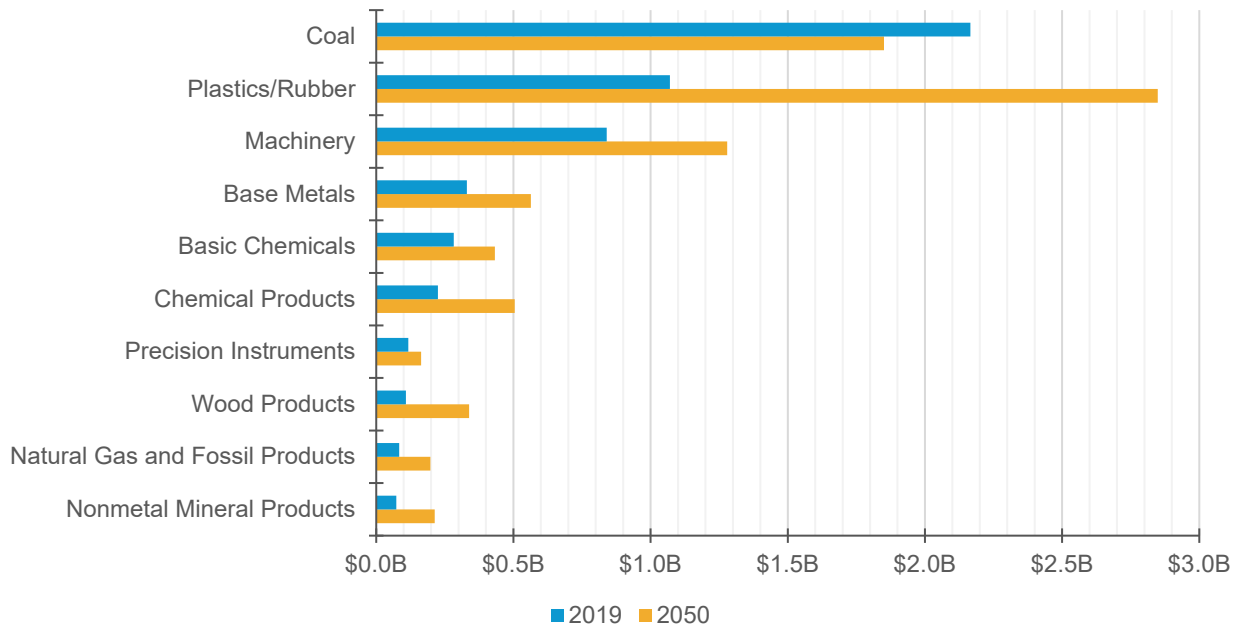
In 2019, coal (\$2 billion), plastics/rubber (\$1 billion), machinery (\$840 million), base metals (\$331 million), and basic chemicals (\$283 million) were the leading commodity types. The top 10 commodities made up approximately 83 percent of the total foreign outbound value. In 2050, plastics/rubber (\$3 billion), coal (\$2 billion), machinery (\$1 billion), base metals (\$564 million), and chemical products (\$505 million) are projected to be the leading commodity types in terms of foreign outbound value. The top 10 commodity types are projected to make up nearly 75 percent of the total 2050 international outbound value.

**Figure 2-17: WV Top 10 International Export Commodities by Tonnage, 2019 and 2050**



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-18: WV Top 10 International Export Commodities by Value, 2019 and 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

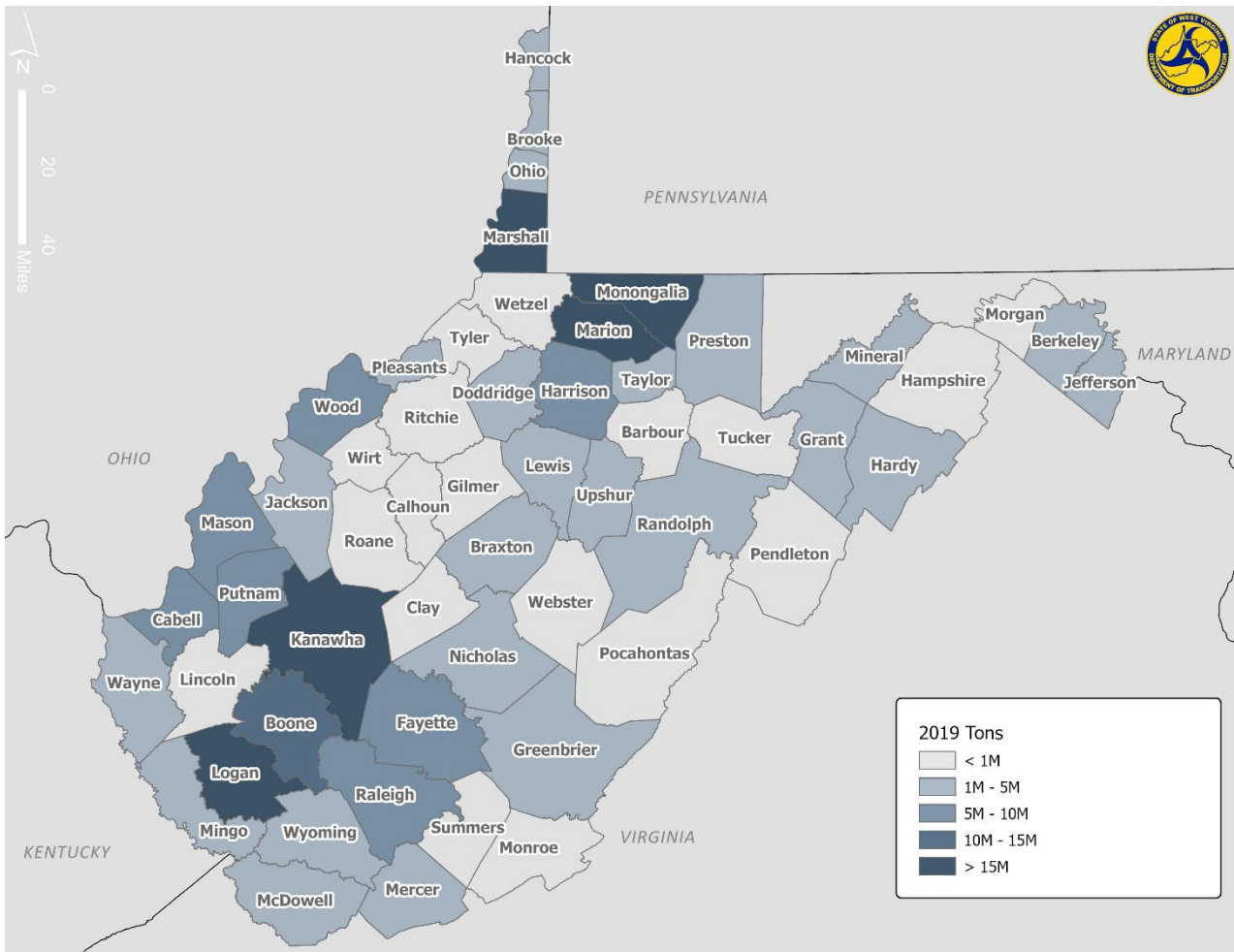
## 2.6 County-Level Trade

Figure 2-19 to Figure 2-22 show the top West Virginia counties by inbound and outbound freight value and tonnage in 2019 and 2050. While freight movement is critical to economies across all of West Virginia, the distribution of freight activity and freight value is highly variable by county. Counties with high concentrations of industries and resources and access to the freight transportation network (including Interstate highways) show more freight activity.

In 2019, Kanawha County, Marion County, Marshall County, Logan County, and Monongalia County were the top counties in terms of freight tonnage, accounting for 43 percent (98 million tons) of the State's inbound and outbound tonnage. By 2050, the State's combined inbound and outbound tonnage generated by these counties is projected to decline by 28 percent to 70 million tons.

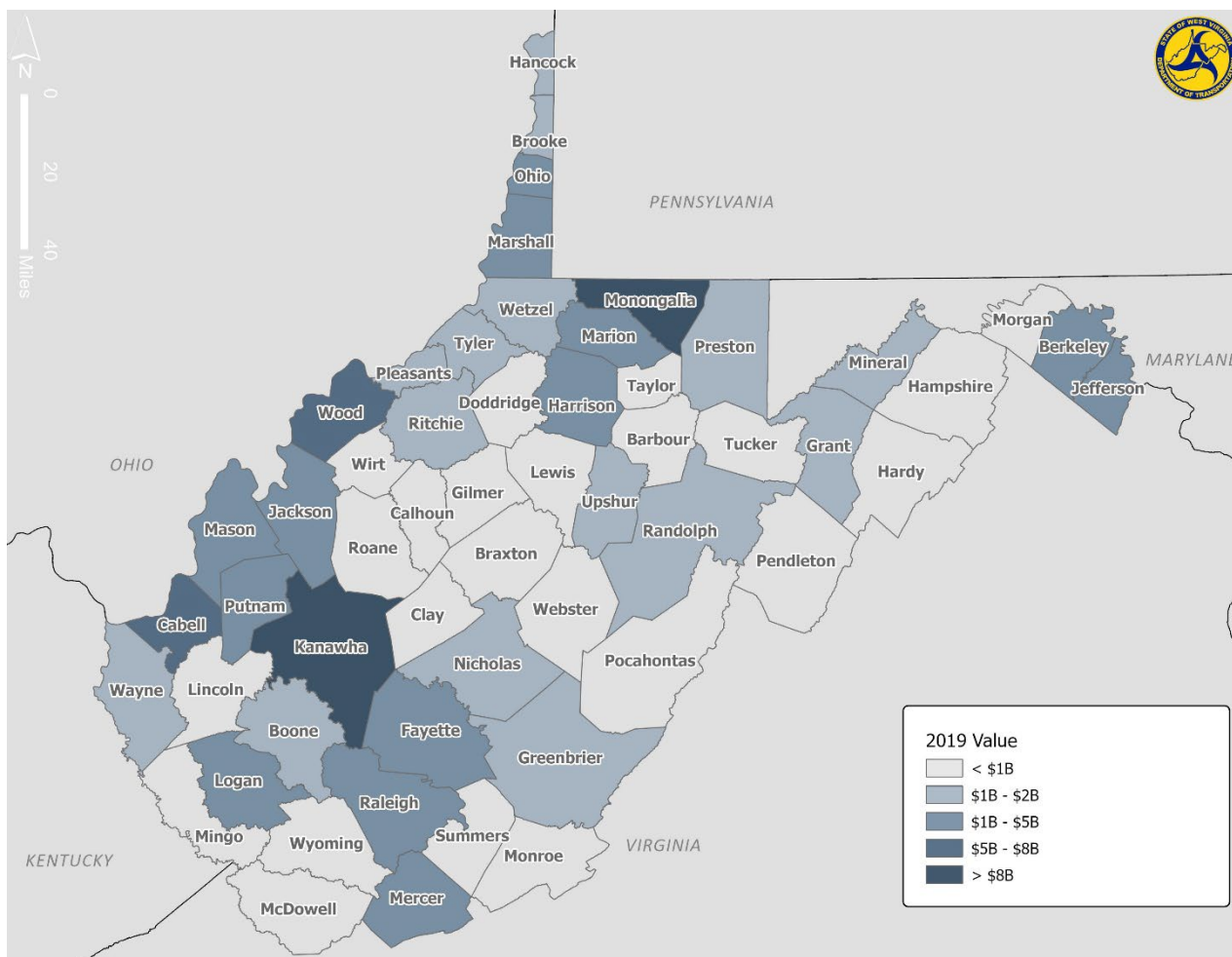
When measured by freight value Kanawha, Monongalia, Cabell, Wood, and Berkeley were the leading counties in 2019, and projected to be the lead in 2050. In 2019 these counties accounted for 37 percent (\$38 billion) of the state's inbound and outbound freight value. By 2050, the state's combined inbound and outbound freight value generated by these counties is projected to more than double to \$77 billion.

Figure 2-19: Top West Virginia Counties by Inbound and Outbound Tonnage, 2019



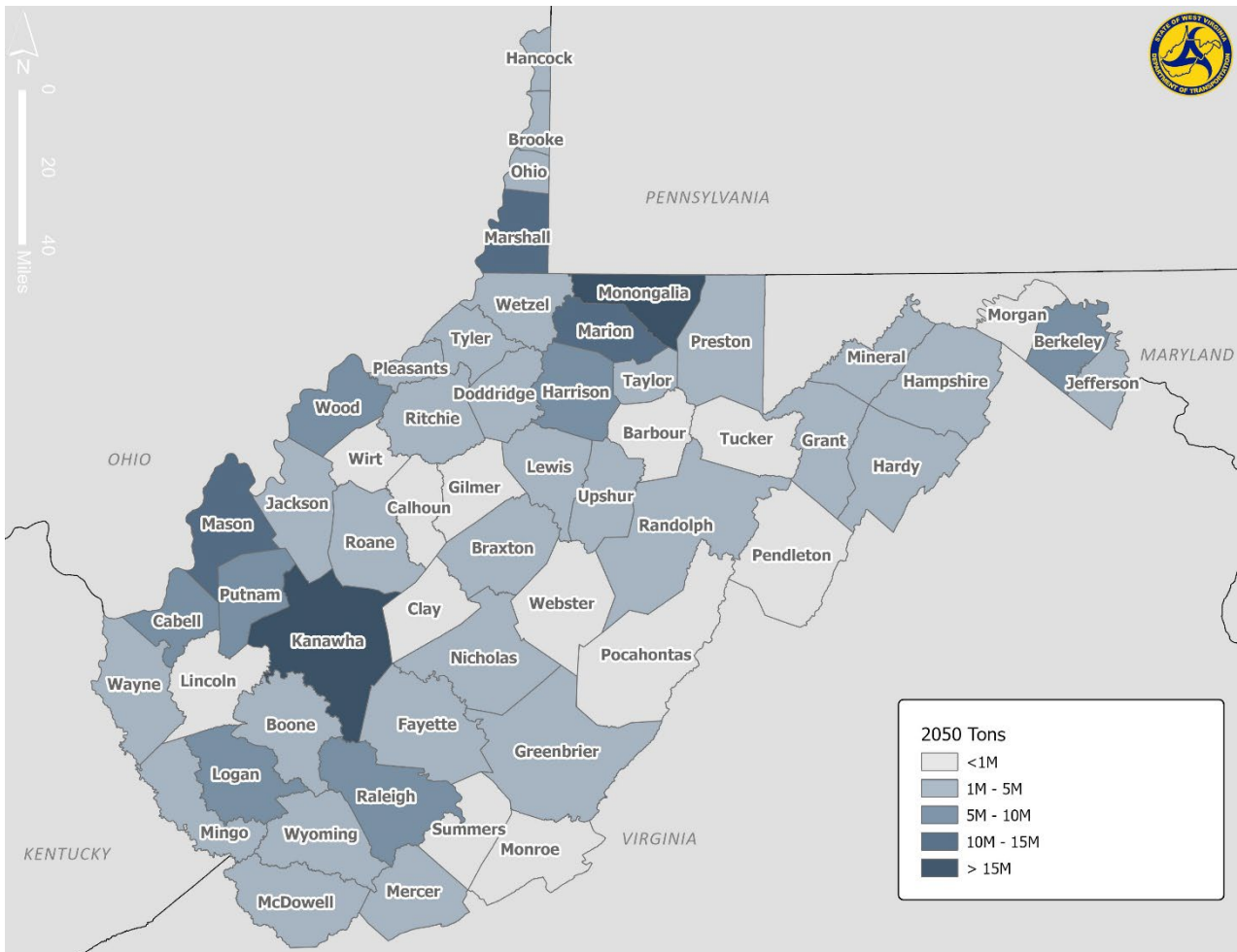
Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

Figure 2-20: Top West Virginia Counties by Inbound and Outbound Value, 2019



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

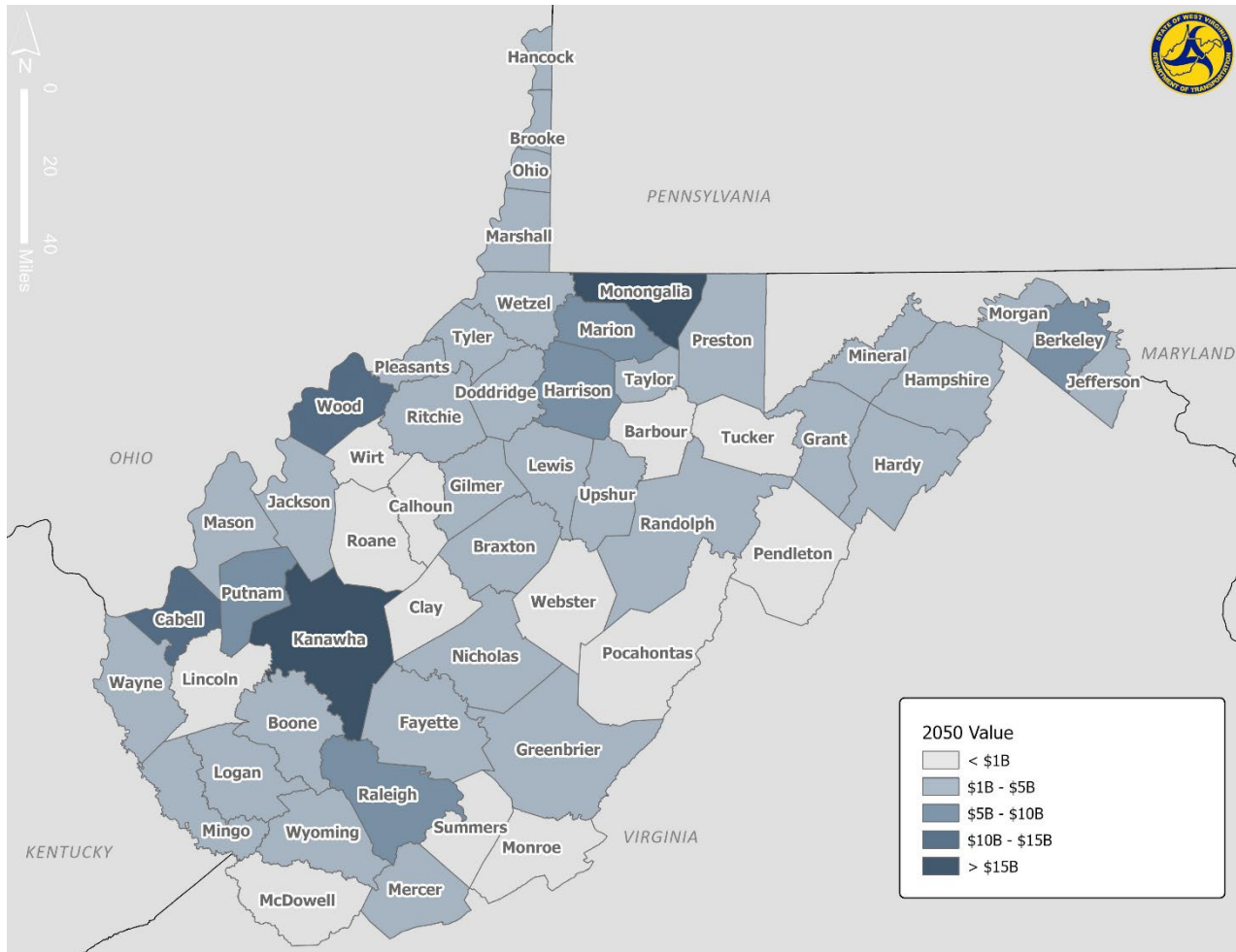
Figure 2-21: Top West Virginia Counties by Inbound and Outbound Tonnage, 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.



Figure 2-22: Top West Virginia Counties by Inbound and Outbound Value, 2050



Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.

## 2.7 West Virginia Freight Analysis System Tool

The West Virginia Freight Analysis System Tool uses the disaggregated FAF 5.4.1 database. It allows users to interactively examine West Virginia freight movements and trends by mode, direction, tonnage, and value by year at the Statewide, District, MPO, and County levels. The base year of this tool is 2019, with the forecast years of 2035 and 2050. Click [here](#) to view the tool.